Layers in Artificial Neural Networks (ANN)

Definition :

In **Artificial Neural Networks (ANNs)**, layers refer to the different stages of processing units (neurons) that transform input data into output predictions. An ANN typically consists of three main types of layers:

* INPUT LAYE
* HIDDEN LAYER
* OUTPUT LAYER

Types of Hidden Layers in Artificial Neural Networks :

1. **Input Layer**:
   * The first layer that receives raw data.
   * Each neuron in this layer represents a feature of the input.
   * It does not perform any computation, just passes the data forward.

### ****Example:****

If an image of **28×28 pixels** is used as input, there will be **784 neurons** (28×28=784) in the input layer.

1. **Hidden Layer(s)**:
   * One or more intermediate layers between the input and output.
   * Neurons in these layers apply weights, biases, and activation functions.
   * These layers extract and learn complex patterns from data.

**Key Components in Hidden Layers:**

1. **Weights & Biases**
   * Weights determine the strength of connections between neurons.
   * Bias helps shift the activation function to optimize learning.
2. **Activation Functions**
   * Used to introduce non-linearity into the network.
   * Common types:
     + **ReLU (Rectified Linear Unit)** → Used in deep networks.
     + **Sigmoid** → Used for binary classification.
     + **Tanh** → Used for balanced positive/negative outputs.

**Example:**

A simple ANN for image classification could have:

1. **Output Layer**:
   * The final layer that produces the network’s prediction.
   * The number of neurons in this layer corresponds to the number of possible outputs.
   * Uses activation functions like **softmax** (for classification) or **linear** (for regression).

**Example of a 3-Layer ANN:**

(Input Layer) → (Hidden Layer 1) → (Hidden Layer 2) → (Output Layer)

Types of ANNs Based on Layers:

|  |  |  |  |
| --- | --- | --- | --- |
| |  | | --- | | **Type** |  |  | | --- | |  | | Description |
| |  | | --- | | **Single-layer Perceptron (SLP)** |  |  | | --- | |  | | |  | | --- | | Has only an input and output layer, no hidden layers. Used for simple classification problems. |  |  | | --- | |  | |
| |  | | --- | | **Multi-layer Perceptron (MLP)** |  |  | | --- | |  | | Has one or |

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